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CO-ORDINATING A TRAFFIC PREEMPTION SYSTEM ON CRISIS VEHICLES

[1]Lingutla Ramesh Naidu,[2]Gangavaram Veera Sankar Reddy,[3]G Surendra,[4]Gaddam Padmavathi
[1]Assistant Professor,[234]Associate Professor Department Of EEE Tadipatri Engineering College,Tadipatri,AP

ABSTRACT:
In today's day and age, cars have become a daily necessity and the chief mode of transport for the majority of the people, especially the working class city dwellers. Over the past few years motor vehicles have become cheaper, fuel efficient and easily accessible, hence become a much needed utility. The number of cars owed per family in India has increased, thereby increasing the amount of traffic that threads the city streets. Even-though, new roads-ways are being built every day through the country, traffic jams in intersections don't seem to reduce. Directing traffic has become one of the major concerns for the common man and more so for hospitals, police officers and fire fighters in the cities. Numerous case have emerged regarding delay in rescue operations due to intense traffic jams. The following paper discusses this issue and proposes an alternative to the currently established system of preprogrammed traffic lights in Indian cities. This project makes use of an RF transmitter-receiver module and a Zigbee transmitter-receiver along with Atmega 328 ICs to demonstrate the concept. This system enables Emergency vehicles (e.g. Fire-trucks, Police Cars, Ambulances) to override the current traffic sequence and reach its destination uninterrupted. The entire system depends on the communication between the Emergency Vehicles (EV) and the traffic signals.

INTRODUCTION

India is a densely populated country housing around 1.2 billion people. Cities like Mumbai have seen a constant in-flux of people. With an ever increasing population directing traffic around the city becomes difficult. Traffic lights in most of the cities in India work on a pre-programmed logic. This logic is static and does not change with the change in traffic density neither does it recognize emergency vehicles. Many a times ironically these static traffic signals cause more traffic congestions, thereby requiring human intervention. Emergency Vehicles are affected most by these traffic congestions. Many cases have been reported where delay at the hands of Emergency Vehicles due to traffic congestion led to the loss of life. Congestion of traffic has been a rapidly growing problem and needs to be dealt with.

2. LITERATURE SURVEY

While coming up with a solution to tackle this problem, many proposed projects where researched. Paper proposed by Sireesha, D. Rakesh [1] talks about a system wherein RF transmitters and receivers are used to communicate between the EV (Emergency Vehicle) and the traffic lights. Zigbee based communication is used to create an intelligent network between all the traffic lights in close proximity and create a failsafe system that gave higher priority to the EV's. However this system is expensive and difficult to incorporate with already installed traffic management systems. Siuli Roy [2] and N. M. Z. Hashim [3] devised a

system where the EV is tagged with a unique ID which can be detected by the RF sensor mounted near the signals. These ID act as a trigger which enable the EV to overwrite the signal. Here the key element is the RFID, and installing them in every vehicle. The detection system also needs to be installed at every signal, which could be cumbersome. Interesting projects were proposed by Sachin Grover [4] and Pratyush Parida [5] which utilized a dual tone multi frequency (DTMF) circuitry along with a microcontroller which enabled the EV to preempt the traffic signal. The driver calls the cellular phone that is installed in the signal and prompts it to override the signal by dialing in the password. The DTMF detects and cross verifies the password and changes the signal accordingly allowing the EV to pass. Here every signal need to have a cell phone, an GSM SIM and a DTMF circuit for it to work which makes the entire system expensive. In Paper [6], Kwon, Eil, Sangho Kim, and Rober Betts talk about combining an online route selection module and a sequential dynamic preemption strategy, so that traffic queues at the intersection on a given emergency route can be cleared in advance for an emergency vehicle, while minimizing delay due to unnecessary preemption. This particular strategy was simulated in real traffic using a microscopic simulation model, which was calibrated with the emergency vehicle travel time data collected from the sample network. Paper [7] has Yuvaraj, N., V. B. Prakash, and D. Venkatraj explaining that it is a paper that may be considered as a combination of both pervasive computing and differential GPS which relates to control automatic traffic signals in such a way as to preempt normal signal operation and permit lifesaving vehicles. This system contains ubiquitous computing, differential GPS, fleet management system, wireless transmitter and receiver computerized median i.e. linked blocks which are removable.

3. METHODOLOGY

This project involved step-wise amalgamation of various communication techniques. Firstly, we have RF 434 MHz module, that consists of a transmitter-receiver pair. Its range is about 200 meters and is very effective in short range communication. However, modules of longer range are available in the market that can be used. The RF receiver will be connected to a microcontroller, which will also be connected to a Zigbee(Series 2) module. The central processor recognizes the lane of the emergency vehicle by means of the Zigbee communication. Once the Zigbee receiver receives the data, it triggers the AtMega 328 at the traffic signal. This controller is connected to another controller in a master-slave combination. The slave is connected to the traffic lights of the four lanes. Also, the master controller is connected to a data logging system. When the Emergency vehicle arrives at the traffic signal, the RF transmitter in the Emergency Vehicle will first send data to the RF receiver, which in turn will trigger the Zigbee transmitter through the controller. Subsequent to the Zigbee communication, the pre-coded master will recognize the lane and cause the interruption accordingly. In this process, data logging will also produce the timestamp and lane name for the signal. A rough figure for the process is shown below:

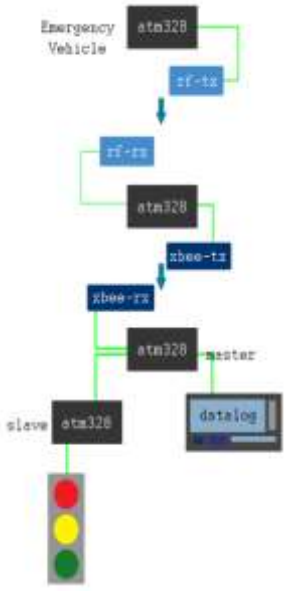

Figure 1

The working of PLX-DAQ is show n through an image as follows:

Figure 2

4. RESULTS AND DISCUSSION

Ruling out the possibility of a system equipped with a sound-detection based preemption system, we used wireless communication to trigger the signals in this framework. We use the Serial Monitor (COM port) window of the Arduino IDE to verify the signal transmission-reception and latency of the signal. At every juncture, we can always connect an Arduino and check whether communication is taking place properly or not. For example, junk data received on the monitor signifies that there is some problem with the code. At the actual traffic junction itself, we use a software called PLX-DAQ, a product of Parallax and meant for Data Acquisition systems. This software enables to view the data received on the COM port in MS Excel sheets. The timestamps are visible as coded in source code. One major disadvantage in this case is that the software now works only on older versions of Excel.

The range for the Zigbee modules is about 300-400 feet, whereas that for the RF modules is 10-15 feet (4-5 metres). The Zigbee modules need to be first configured using software's like XCTU, wherein the module is set up as either a receiver or a coordinator. Our project is easy to implement and cost effective. Also, the coding in Arduino is pretty straightforward C programming and virtually undemanding.

5. CONCLUSION AND FUTURE SCOPE

The system developed in this paper is a prototype. The components used were short-range and low power. The performance and usability of the apparatus can be greatly increased by using superior quality devices. For example, the range of 434 MH_Z RF Module is about 3-4 metres. However, there are more powerful modules available in the market, which will easily increase the range of the communication to over 400-500 metres. Similarly, the Zigbees that we use are of a low range. But there are Zigbee modules with better range available in the market, one which can potentially exceed 10-100 metres. Let us take a look at the future scope. The signal being used for communication can be encrypted and for a more secure connection. Furthermore, the system can be modified by adding a Global Positioning System (GPS), which will utilize online desktop mapping service Google Maps for tracking the whereabouts of the Ambulance. Traffic can be cleared before the arrival of the emergency vehicle. Another future scope is using the Preemption System in combination with Image Processing. CCTVs can be installed at each junction and the number plates of each vehicle can be scanned. Traffic density controllers can also be used by placing the sensors on both ends of a lane. All the above lead to smart traffic system management which are synonymous with railroad preemption system or a bus rapid-transit system.

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